REMARKS

Claims 1-6 are pending and stand ready for further action on the merits. Claims 4 and 5 have been withdrawn from consideration as being drawn to non-elected subject matter.

Support for the amendment to claim 1 can be found in the specification at page 7, line 26 to page 10, line 12. New claim 6 finds support at page 9, lines 22-23 of the specification. No new matter has been added by way of the above-amendment.

The following sections correspond to the sections of the outstanding Office Action.

Restriction

The Examiner has imposed a Restriction Requirement under 35 U.S.C. §121 and has separated the claims into the following two groups:

I. Claims 1-3, drawn to a resin composition, classified in class 430, subclass 285.1.

II. Claims 4-5, drawn to a printed wiring board and a cured resin, classified in class 428, subclass 209.

Applicants confirm the election of Group I consisting of claims 1-3, drawn to a resin composition, with traverse.

Applicants traverse the Restriction Requirement for the following reasons.

According to MPEP §803, if the search and examination of an entire application can be made without a serious burden, the Examiner *must* examine it on the merits, even though it includes claims to independent or distinct inventions. As evidence of the burden, the Examiner cites a single class/subclass to be searched for each of Groups I and II. Applicants respectfully submit that the search of one additional subclass does not amount to an undue burden placed upon the Examiner to examine all of claims 1-5. As such, Applicants respectfully request the Examiner rejoins claims 4-5 with elected claims 1-3.

In the event that the Examiner maintains the position that there is an undue burden to search both Groups I and II, Applicants respectfully request that the Examiner rejoins claim 5 with elected claims 1-3. Applicants note that the Examiner has restricted out claim 5, drawn to a cured form of the curable resin of claim 1. The Examiner asserts that claim 5 should be restricted from claim 1, since the subject matter of these claims are in the intermediate-final product relationship. Furthermore, the Examiner asserts that these claims are restrictable, since "the intermediate product is deemed to be useful as liquid crystal device or solar cell." Applicants respectfully submit that this logic is relevant to the relationship between the subject matter of claims 1-3 and the subject matter of claim 4 but not as between the subject matter of claims 1-3 and the subject matter of claim 5. In other words, the Examiner appears

to be asserting that the cured resin of claim 5 would not be useful in a liquid crystal device or solar cell. There is no reason of record why the cured resin of claim 5 could not be used in a liquid crystal device or solar cell. As such, Applicants respectfully request rejoinder of claim 5 with claims 1-3.

Informalities in the Specification

In response to the Examiner's objection to the specification, Applicants have removed the typographical errors from page 8, line 6 and page 9, line 4. As such, withdrawal of the objection is respectfully requested.

Issues Under 35 U.S.C. §112, second paragraph

Claims 1-3 are rejected under 35 U.S.C. §112, second paragraph for being indefinite. Applicants respectfully traverse the rejection.

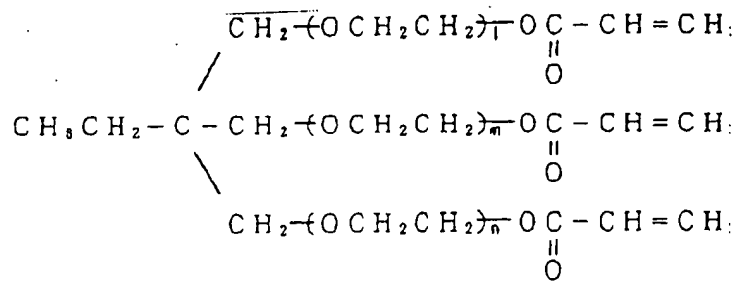
The Examiner states:

> Component (B) is "alkylene oxide-modified product of at least one acrylate selected from (meth)acrylates or oligomers thereof". This (B) is not defined by applicants. Applicants on page 2 refer to ethylene oxide modified trimethylolpropane triacrylate form JP 10-161306A. There is no disclosure in the specification as to what these compounds are. Starting on the bottom of page 7, applicants disclose "an explanation" of (B) which lists a series of (meth)acrylates then on page 10 discloses these compounds are used as raw material for the (B). (B) "can be obtained by treating any of the aforementioned (meth)acrylates or oligomers thereof with an alkylene oxide. This is "can" does not limit (B). The "alkylene oxide-modified product of at least one

> acrylate selected from (meth)acrylates or oligomers thereof" is a product by process kind of language or is it a reference to the structure that would be present that represents the final product of such a modification. The examiner is unclear if a compound like tetrabromobisphenol A diethoxy diacrylate compound count as an "alkylene oxide-modified product of at least one acrylate selected from (meth)acrylates or oligomers thereof" because of the presence of diethoxy groups? Such a compound is "modified" but is not obtained by reacting an acrylate with an alkylene oxide. However, there is a modification from a tetrabromobisphenol A diacrylate compound. Thus, the terminology used by applicants is too vague to allow the examiner to determine if such compounds as ethylene glycol di(meth) acrylate which has the same structure if made from ethylene oxide or ethylene glycol. The structure is the same.

Applicants respectfully submit that the above-amendment to the specification clarifies the extent of component (B). Also, it is clear from the amendment to claim 1 that the compounds of component (B) must include an "OCH_2CH_2" (ethylene oxide) or an "$OCH_2CH_2CH_2$" (propylene oxide) moiety.

As noted in the Examiner's statement repeated above, the Examiner indicates that there is a description of compounds encompassed by the inventive component (B) in JP 10-161306A (hereinafter JP '306). In response, Applicants enclose herewith a copy of page 3 of JP '306 which recites the chemical formula of an ethylene oxide-modified trimethylolpropane triacrylate. This formula is now described herein for the Examiner's convenience.



Wherein L, M and N are respectively 0 or a positive number.

Applicants respectfully submit that the aforementioned description of JP '306, allows one to understand the chemical formula for the ethylene oxide-modified trimethylolpropane triacrylate. In light of this disclosure, Applicants believe that other compounds coming within the purview of inventive component (B) can be readily understood as they are compounds of the same kind.

Furthermore, the specific compounds used as inventive component (B) in the examples are described on page 15 of the specification; and are B1 (Aronix M-360), B2 (Aronix M-350) and B3 (Aronix M-320X). Each of the Aronix compounds are available from Toagosei Chemical Industry Co., Ltd. The enclosed catalog of Toagosei Chemical Industry Co., Ltd. relating to Aronix (Attached document 1) describes on page 5 the chemical formulas and names of Aronix M-360, 350 and 320 used in the Examples.

Aronix M-360 and Aronix M-350 are both ethylene oxide-modified trimethylolpropane triacrylates and the two differ from each other only in the number of repeating unit n. The number of modification (or number of addition) is calculated as 3 X n.

Aronix M-320 is propylene oxide-modified trimethylolpropane triacrylate.

Based on the foregoing explanation and the above-amendment, Applicants respectfully submit that the scope of "component (B)" in claim 2 is clarified to the extent required by 35 U.S.C. §112, second paragraph. As such, withdrawal of the rejection is respectfully requested.

Watanabe, U.S. 5,721,076 and Grant et al. (Grant and Hackh's Chemical Dictionary, 5th Edition, page 24, 1987)

Claims 1-3 are rejected under 35 U.S.C. §103(a) as being unpatentable over Watanabe as evidenced by Grant et al. Applicants respectfully traverse the rejection.

Advantages of the Present Invention

The present invention relates to a photo- or heat-curable resin composition suitable for insulating a printed wiring board and to a multi-layer printed wiring board and to a multi-layer printed wiring board containing an insulating resin layer formed from said photo- or heat-curable resin composition. The inventive photo- or heat-curable resin composition comprises 10-100 parts by weight of component (B) which is at least one acrylate selected from (meth)acrylates or oligomers thereof, wherein said at least one acrylate is modified with ethylene oxide or propylene oxide. Applicants respectfully submit that

the insertion of the ethylene oxide or propylene oxide moiety into the at least one acrylate, gives a photo- or heat-curable resin composition having a high glass transition temperature (Tg) and high resolution and the cured product thereof has excellent crack resistance.

This is clearly proved by the examples in the specification of the present patent application where dipentaerythritol hexaacrylate (component E1) or trimethylolpropane triacrylate (component E2) is used in place of Component (B). The resulting product does not manifest reliability. For example, comparison of Examples 1-4 (where alkylene oxide-modified Component (B) or B1, B2 or B3 is used) and Examples 5-7 (where a component not modified by an alkylene oxide or E1 or E2 is used) reveals a large difference in reliability between the two groups of examples, namely, 95-100% in the former versus 0% in the latter.

The above-explanation has been provided to highlight the patentable distinctions between the present invention and the cited references.

Watanabe

Watanabe discloses photosensitive resin compositions and suggests their applications to interlayer insulating materials for printed wiring boards. However, the optional components or photo-polymerizable monomers and oligomers to be used in the photosensitive resin compositions therein disclosed are nothing

more than conventional acrylic monomers. Watanabe fails to teach or suggest the inventive Component (B) which is modified by an alkylene oxide. According to the present invention, the use of Component (B) helps to produce insulating resins which show good resolution and heat resistance and high reliability in the thermal shock test.

In Watanabe, there is no teaching or suggestion of Component (B) nor of the high reliability resulting from its use. None of acrylates cited as examples in Watanabe is modified by an alkylene oxide. For example, a glycol acrylate in Watanabe is represented by CHR=CH-COO-R'-OOC-CH=CHR (R is H or Me and R' is an alkylene group), whereas the inventive compounds are modified by an alkylene oxide (R"0). A typical example of the inventive compounds is represented by $CHR=CH-COO(R"0)_n-R'-(R"0)_n OOC-CH=CHR$ (wherein R" is an alkylene group).

The Examiner cites Grant et al. for teaching a definition of "alkylene oxide." Accordingly, Grant et al. fails to cure the deficiencies in the teachings of Watanabe.

As the MPEP directs, all the claim limitations must be taught or suggested by the prior art to establish a *prima facie* case of obviousness. Since neither Watanabe nor Grant et al. teach or fairly suggest a composition comprising inventive component (B), Applicants respectfully submit that the combination of Watanabe and Grant et al. do not make obvious the present invention.

In addition, even if a prima facie case of obviousness were to exist (which it does not), Applicants respectfully submit that the presently claimed resin composition has unexpectedly superior properties to the resin composition of Watanabe thereby rendering the prima facie case moot. As noted above, **Applicants have essentially repeated the experiments of Watanabe** to show that the specific acrylate used by Watanabe in Examples 1, 3, 5 and 17-21, i.e., dipentaerythritol hexaacrylate is inferior to the inventive component (B). As can be seen from the data in Table 2 on page 18 of the specification, the reliability of the inventive compositions (Examples 1-4) incorporating alkylene oxide modified acrylates is unexpectedly superior to the reliability of the compositions using dipentaerythritol hexaacrylate of Watanabe (Examples 5 and 7).

Applicants respectfully submit that the advantages of using an acrylate modified by alkylene oxide are neither taught nor suggested by the cited references. Accordingly, if a *prima facie* case of obviousness were to exist, the *prima facie* case would be rendered moot.

Watanabe and Cohen, U.S. 3,380,831

Claims 1-3 are rejected under 35 USC 103 as being unpatentable over Watanabe in view of Cohen. Applicants respectfully traverse the rejection.

Applicants comments regarding the patentable distinctions between the present invention and the teachings of Watanabe as described above, are herein incorporated by reference in their entirety.

Cohen fails to teach or fairly suggest the inventive combination of Component (B) and Component (A). Moreover, Cohen fails to teach or suggest the unexpected improvement to the reliability of a printed wiring board incorporating the inventive resin composition which includes a combination of Components (B) and (A).

In addition, the acrylates used in Watanabe [for example, ethylene glycol di(meth)acrylate] are added for the purpose of controlling the viscosity, see column 10, lines 42-43. On the other hand, the acrylates of Cohen are added for the purpose of reducing toxicity. Therefore, there is no motivation for one to combine Watanabe and Cohen. The mere fact it is possible for isolated disclosures to be combined does not render the result of that combination obvious absent a logical reason of record which justifies the combination. *In re Regel et al.* (CCPA 1975) 526 F2d 1399, 188 USPQ 136.

Accordingly, the skilled artisan would not be motivated to replace the acrylates of Watanabe with the alkylene oxide modified acrylates of Cohen, since the acrylates of Watanabe are useful in controlling the viscosity, whereas the alkylene oxide acrylates of Cohen are added to reduce the toxicity.

Since there would be no motivation to combine the two references to obtain the present invention, withdrawal of the rejection is respectfully requested.

Kushi et al., U.S. 4,970,135

Claims 1 and 3 are rejected under 35 U.S.C. §102(b) as being anticipated by Kushi et al.

Applicants respectfully traverse the rejection.

In describing the requirements for rejection of a claim by anticipation, the Manual of Patent Examining Procedure (Section 2131) states:

> A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference (ref. omitted). The identical invention must be shown in as complete detail as is contained in the... claim (ref. omitted).

Accordingly, every element in a claim must be found in the reference in order that the reference anticipates the claim. The Examiner cites Example 1 of Kushi et al. for anticipating the present invention. The Examiner is equating tetrabromobisphenol A diethoxy diacrylate as being encompassed by inventive Component (B). Applicants respectfully submit that in view of the above-amendment clarifying Component (B), Example 1 of Kushi et al. does not anticipate the present invention. As such, withdrawal of the rejection is respectfully requested.

Conclusion

In view of the above amendments and comments, Applicants respectfully submit that the claims are in condition for allowance. A notice to such effect is earnestly solicited.

Pursuant to the provisions of 37 C.F.R. §§ 1.17 and 1.136(a), the Applicants hereby petition for an extension of two (2) months to August 27, 2003 in which to file a reply to the Office Action. The required fee of $410.00 is enclosed herewith.

If the Examiner has any questions concerning this application, he is requested to contact Garth M. Dahlen, Ph.D. (#43,575) at the offices of Birch, Stewart, Kolasch & Birch, LLP.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By _____
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Enclosures: A) Copy of "Aronix" and
B) page 3 of JP '306

(1)

ARONIX®

M Series

Acrylic Type Oligomers & Monomers

TOAGOSEI

What is Aronix?

Aronix is the brand name for special acrylic monomers and oligomers developed by Toagosei Co., Ltd. Aronix on the market includes special acrylates,urethane acrylates, and polyester acrylates.

● Special acrylates

Generally, this type has low viscosity, low irritation and excellent light curing. Therefore, these acrylates are effective in lowering the viscosity of acrylic oligomers and are used as a reactive diluent to improve the adhesiveness, heat-resistance, hardness, and curing of acrylic oligomers.

● Urethane acrylates

This type has urethane bonding as its major chain, so its coating film is very tough. It has good adhesiveness with various materials.

● Polyester acrylates

This type has ester bonding as its major chain and two or more acrylic unsaturated bonds in its molecule. It is easily liquidized at lower viscosities than other acrylic oligomers and has good compatibility with other polymers or oligomers.

Various curing methods are available by using these features of Aronix. Moreover, hard to soft types can be designed for different uses and functions by bonding various molecules.

Curing Aronix

The following table lists typical curing methods for Aronix.

Curing methods		Catalyst System Sample
Radical polymerization	Heat curing : furnace,infrared, and microwave	Add catalyst (radical generator) such as benzoyl peroxide and dicumyl peroxiced.
	Normal temperature curing by redox polymerization	Add benzoylperoxide (dimethylanilin) or cumenehydroperoxide (vanazium system accelerator).
	Anaerobic curing	Add hydroperoxide, tertiary amine,sulfonamide.
	UV curing	Add light initiator (benzoin alkylether, benzophenone, acetophenone, etc.).
	Electron-beam curing	No catalyst
Michael Addition Polymerization	Normal temperature and heat curing	Add polyamine containing primary and secondary amino groups.

Types of ARONIX

Aronix is classified according to the resin structure and the number of acryloyl groups as listed in the following tables.

Special acrylates

	Grade	Chemical Nomenclature	General Code	Feature
Monofunctional	M-101	Phenol polyethoxylate acrylate (n≒2)		Low viscosity Low toxicity Good pliability
	M-111	Nonylphenol polyethoxylate acrylate (n≒1)		
	M-113	Nonylphenol polyethoxylate acrylate (n≒4)		
	M-117	Nonylphenol polypropoxylate acrylate (n≒2.5)		
	M-120	2-Ethylhexylcarbitol acrylate		
	M-150	N-Vinyl-2-pyrrolidone	N-VP	
Bifunctional	M-211B	Bisphenol-A polyethoxylate diacrylate (n≒2)	A-BPE4	Low viscosity Low toxicity
	M-215	THEIC (Trishydroxyethyl isocyanurate) diacylate		
	M-220	Tripropyleneglycol diacylate	TPGDA	
	M-225	Polypropyleneglycol diacrylate (n≒7) (PPG#400)	PPGDA	
	M-233	Pentaerythritol diacrylate monostearate		
	M-240	Tetraethyleneglycol diacrylate (n≒4) (PEG#200)	TEGDA	
	M-245	Polyethyleneglycol diacrylate (n≒9) (PEG#400)	PEGDA	
	M-270	Polypropyleneglycol diacrylate (n≒12)	PPGDA	
Trifunctional	M-305	Pentaerythritol triacrylate	PETA	Low viscosity Low toxicity Good curing
	M-309	Trimethylolpropane triacrylate	TMPTA	
	M-315	THEIC (Trishydroxyethyl isocyanurate) triacrylate (n≒3)		
	M-320	Trimethylolpropane Polypropoxylate triacrylate (n≒2)		
	M-350	Trimethylolpropane polyethoxylate triacrylate (n≒1)		
	M-360	Trimethylolpropane polyethoxylate triacrylate (n≒2)		
Multi-functional	M-400	Dipentaerythritol penta- and hexa-acrylate	DPHA	Low toxicity Good curing High hardness
	M-408	Ditrimethylolpropane tetra-acrylate	DTMPTA	
	M-450	Pentaerythritol tetra-acrylate		

Urethane acrylates

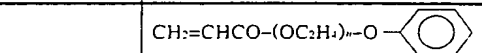
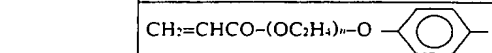
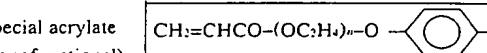
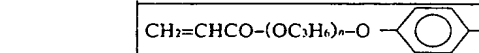
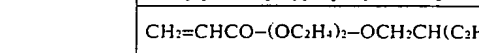
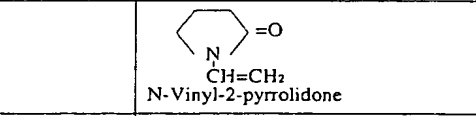
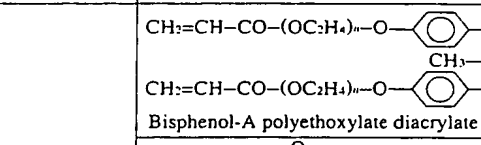
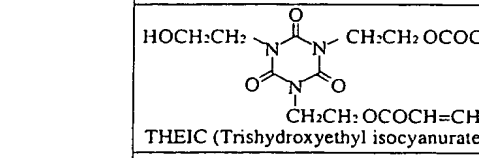
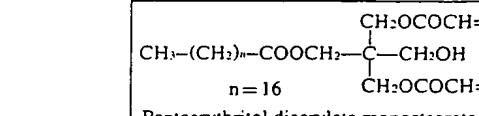
Functional group number	Grade	Features
Bifunctional	M-1200	Non-yellowing and medium-hard type
	M-1600	Non-yellowing, fast-curing and medium-hard type

Special acrylates

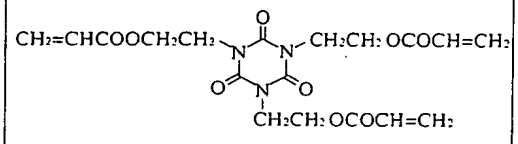
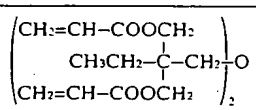
Functional group number	Grade	Features
Monofunctional	M-5000 Series	-COOH and -OH group monomer

Polyester acrylates

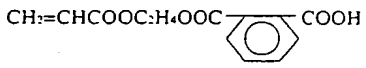
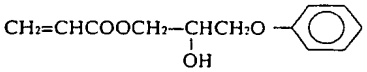
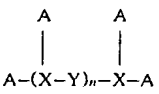
Functional group number	Grade	Features
Bifunctional	M-6000 Series	Low toxicity and low viscosity
Multi-functional	M-7000 Series	Low toxicity,high gloss and good curing
	M-8000 Series	Low toxicity,high hardness and good curing
	M-9000 Series	Heat resistance, high hardness and good curing

Trade names	Types of products	Structural formula	Color (APHA)	Viscosity (mPa·s/℃)	Residual (%)	Acid value (mgKOH/g)	Specific gravity (/℃)
M-101A	Special acrylate (Monofunctional)	 Phenol polyethoxylate acrylate (n≒2)	< 300	10-20/25	< 1	< 1	1.110/25
M-111		 Nonylphenol monoethoxylate acrylate (n≒1)	< 350	60-90/25	< 1	< 1	1.000/25
M-113		 Nonylphenol polyethoxylate acrylate (n≒4)	< 200	80-110/25	< 1	< 0.5	1.031/25
M-117		 Nonylphenol polypropoxylate acrylate (n≒2.5)	< 200	90-140/25	< 1	< 0.5	0.990/25
M-120		 2-Ethylhexylcarbitol acrylate	< 150	4-7/25	< 1	< 0.3	0.946/25
M-150 (N-VP)		 N-Vinyl-2-pyrrolidone	—	2/25	—	—	1.040/25
M-211B (A-BPE4)	Special acrylate (Bifunctional)	 Bisphenol-A polyethoxylate diacrylate (n≒2)	< 300	900-1,300/25	< 1	< 2	1.154/25
M-215		 THEIC (Trishydroxyethyl isocyanurate) diacrylate	< 100	3,500-15,000/25	4-9	< 1.3	1.293/25
M-220 (TPGDA)		CH_2=CHCO–$(OC_3H_6)_3$–OCOCH=CH_2 Tripropyleneglycol diacylate	< 250	8-16/25	< 1	< 1	1.030/25
M-225 (PPGDA)		CH_2=CHCO–$(OC_3H_6)_n$–OCOCH=CH_2 Polypropyleneglycol diacrylate (n≒7)	< 200	30-40/25	< 1	< 1	1.026/25
M-233		 Pentaerythritol diacrylate monostearate	—	80-280/50	< 1	< 4	—
M-240 (TEGDA)		CH_2=CHCO–$(OCH_2CH_2)_n$–OCOCH=CH_2 Tetraethyleneglycol diacrylate (n≒4)	< 100	13-24/25	< 1	< 1	1.111/25
M-245 (PEGDA)		CH_2=CHCO–$(OCH_2CH_2)_n$–OCOCH=CH_2 Polyethyleneglycol diacrylate (n≒9)	< 100	30-70/25	< 1	< 1	1.112/25
M-270 (PPGDA)		CH_2=CHCO–$(OC_3H_6)_n$–OCOCH=CH_2 Polypropyleneglycol diacrylate (n≒12)	< 200	60-80/25	< 1	< 1	1.016/25

Flash point (℃)	Inhibitor (MEHQ,ppm)	Skin Irritation (PII)	TSCA Registration (CAS No.)	Properties of cured film			Package	Characteristics
				Tensile strength (kg/cm²)	Elongation (%)	Tg (℃)		
133	160	0.7	56641-05-5	—	—	−8	17kg 190kg	Low odor. Very low skin irritation.
156	130	2.0	50974-47-5	6	250	17	17kg 190kg	High compatibility.
224	120	1.1	50974-47-5	1	50	−20	17kg 190kg	Low curing Tg.
195	200	0.6	71926-19-7	3	60	−3	17kg 190kg	
140	500	3.0	—	—	—	−65	16kg 180kg	Low viscosity. Low curing Tg.
100	—	0.4	88-12-0	—	—	-	18kg 200kg	High curability. Low viscosity. Excellent adherent properties to plastics.
Polymerized at 210℃	450	0.4	56361-55-8	530	0-10	75	18kg 200kg	High curability. Very low skin irritation. Film of high hardness.
35	1500	3.7	Registered	500	0-10	166	18kg 200kg	Monomer of containing-OH group. Excellent heat-resistance. Film of high hardness.
157	400	1.4	42978-66-5	240	0-5	90	17kg 190kg	Very low skin irritation. Low viscosity.
218	100	0.8	—	27	10	−8	17kg 190kg	
Non-fluid	1000	3.5	—	60	0-10	—	18kg	Monomer of containing-OH group. High compatibility with various kinds of oil. Wax type.
Polymerized at 154℃	200	4.0	26570-48-9	190	0-10	50	18kg 200kg	Low viscosity.
Polymerized at 130℃	200	0.9	26570-48-9	24	2	−20	18kg 100kg	
Polymerized at 240℃	100	—	—	9	5	−32	18kg 190kg	

Trade names	Types of products	Structural formula	Color (APHA)	Viscosity (mPa·s/℃)	Residual (%)	Acid value (mgKOH/g)	Specific gravity (/℃)
M-305 (PETA)	Special acrylate (Trifunctional)	$(CH_2=CHCOOCH_2)_3-CCH_2OH$ Pentaerythritol triacrylate	< 100	180-850/25	< 1	< 1	1.181/25
M-309 (TMPTA)		$(CH_2=CHCOOCH_2)_3-CCH_2CH_3$ Trimethylolpropane triacrylate	< 200	60-110/25	< 1	< 1	1.111/25
M-315		 THEIC (Trishydroxyethyl isocyanurate) triacrylate	< 500	600-1,200/50	< 1	< 1	1.388/21
M-320		$[CH_2=CHCO-(OC_3H_6)_n-OCH_2]_3-CCH_2CH_3$ Trimethylolpropane polypropoxylate triacrylate ($n \fallingdotseq 2$)	< 500	70-170/25	< 1	< 2	1.043/25
M-350		$[CH_2=CHCO-(OC_2H_4)_n-OCH_2]_3-CCH_2CH_3$ Trimethylolpropane polyethoxylate triacrylate ($n \fallingdotseq 1$)	< 300	50-70/25	< 1	< 1	1.106/25
M-360		$[CH_2=CHCO-(OC_2H_4)_n-OCH_2]_3-CCH_2CH_3$ Trimethylolpropane polyethoxylate triacrylate ($n \fallingdotseq 2$)	< 200	65-90/25	< 1	< 0.5	1.108/25
M-402 (DPHA)	Special acrylate (Tetrafunctional or more)	$(CH_2=CH-COOCH_2)_3-C-CH_2-O-CH_2-C(CH_2O-R)(CH_2OCOCH=CH_2)_2$ R : H or $-CO-CH=CH_2$ Dipentaerythritol penta- & hexa-acrylate	< 100	4000-6,500/25	< 1	< 0.5	1.188/25
M-408		 Ditrimethyrolpropane tetraacrylate	< 300	400-600/25	< 1	< 1	1.097/25
M-450 (PETTA)		$(CH_2=CHCOOCH_2)_4-C$ Pentaerythritol tetra-acrylate	< 200	60-80/50	< 1	< 1	1.185/50
M-1200	Urethane acrylate (Bifunctional)	$CH_2=CHCOO-R'-OOCNH-$ $-[R-NHCOO-(Polyol)-OOCNH]_n-$ $-R-NHCOO-R'-OCOCH=CH_2$	—	120,000-220,000/50	—	—	1.293/21
M-1600			—	8,000-12,000/50	—	—	—

Flash point (℃)	Inhibitor (MEHQ, ppm)	Skin irritation (PII)	TSCA Registration (CAS No.)	Properties of cured film			Package	Characteristics
				Tensile strength (kg/cm^2)	Elongation (%)	Tg (℃)		
Polymerized at 190℃	550	2.8	3524-68-3	390	0-5	> 250	18kg 200kg	Monomer of containing-OH group. High curability.
167	100	3.2	15625-89-5	230	0-5	> 250	18kg 200kg	High compatibility with various kinds of resins.
Non-fluid	1500	0.1	Registered	700	0-10	> 250	18kg	Wax type. Excellent heat-resistance.
Polymerized at 230℃	500	1.6	53879-54-2	255	4	50	18kg 200kg	
Polymerized at 180℃	180	1.5	28961-43-5	450	3	—	18kg 200kg	High curability.
Polymerized at 200℃	800	2.1	28961-43-5	285	5	53	18kg 200kg	
Polymerized at 190℃	500	0.4	60506-81-2 29570-58-9	—	—	> 250	18kg 200kg	High curability.
Polymerized at 170℃	200	0.0	94108-97-1	—	—	> 250		High compatibility with various kinds of resins. High curability.
199	400	0.4	4986-89-4	—	—	—	18kg 200kg	Wax type. High curability.
Non-fluid		1.3	Registered	250	50	35	18kg	Non-yellowing type. Excellent adherent properties to polyvinyl chloride.
	250	1.8	Registered	350	45	82	18kg	Non-yellowing and fast-curing type. Good weather-proofing.

Trade names	Types of products	Structural formula	Color (APHA)	Viscosity (mPa·s/℃)	Residual (%)	Acid value (mgKOH/g)	Specific gravity (/℃)
M-5300	Oligoester acrylate (Monofunctional)	$CH_2=CHCOO-(C_5H_{10}COO)_n-H$ ω-carboxy-polycaprolactone (n ≒ 2) monoacrylate	—	80-180/25	< 1	160-250	1.087/25
M-5400		 Acryloyloxyethyl Phthalic acid	—	4,000-7,000/25	< 1	190-220	1.275/25
M-5710		 2-Hydoroxy-3-phenoxy-propyl acrylate	< 100	100-270/25	< 1	< 0.5	1.160/25
M-6200	Oligoester acrylate (Bifunctional)	A-(M-N)$_n$-M-A A : Acrylic acid M : Diol N : Dibasic acid	< 150	700-3,700/25	< 1	< 1	1.236-25
M-6250			< 300	300-700/25	< 1	< 1	1.215/25
M-7100	Oligoester acrylate (Trifunctional or more)	 A : Acrylic acid X : Polyol Y : Polybasic acid	< 300	6,500-12,000/25	< 1	< 15	1.160/25
M-8030			< 200	500-700/25	< 1	< 7	1.134/25
M-8060			< 250	5,000-12,000/25	< 1	< 16	1.148/25
M-8530			< 300	350-650/25	< 1	< 10	—
M-8560			< 300	3,000-7,000/25	< 1	< 20	—
M-9050			< 500	6,000-12,000/25	< 1	< 10	1.202/25

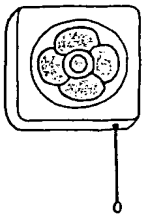
Flash point (℃)	Inhibitor (MEHQ,ppm)	Skin irritation (PII)	TSCA Registration (CAS No.)	Properties of cured film			Package	Characteristics
				Tensile strength (kg/cm^2)	Elongation (%)	Tg (℃)		
158	600	2.0	—	—	—	—	18kg 200kg	Monomer of containing-COOH group.
140	300	4.7	30697-40-6	400	0-5	—	18kg 200kg	Monomer of containing-COOH group. High curability.
133	500	0.9	16969-10-1	12	200-300	17	18kg 200kg	Monomer of containing-OH group. Film of softness and high elongation.
160	500	2.3	Registered	150	35	35	18kg	
159	400	2.1	Registered	100	30	45	18kg	
Polymerized at 160℃	500	0.5	Registered	500	5-10	105	18kg	Film of high gloss. High curability. Film of high hardness.
162	250	3.0	Registered	300	5-10	> 250	18kg 200kg	High compatibility with various kinds of resins. Excellent heat-resistance.
Polymerized at 140℃	350	3.5	Registered	400	5-10	> 250	18kg 200kg	High compatibility with various kinds of resins. Excellent heat-resistance.
—	400	—	Registered	490	—	—	18kg 200kg	Faster curing than M-8030.
—	500	—	Registered	520	—	—	18kg 200kg	Faster curing than M-8060.
Polymerized at 150℃	700	3.4	—	580	0-5	> 300	18kg 200kg	Excellent heat-resistance.

Handling Aronix

Aronix is a low-or medium-level skin irritant; fumes from the liquid at heating or UV curing may cause skin problems. (See *Primary Irritation Index*.)
Symptoms includes itching, red rash, and blisters. Therefore, take the following precautions when handling Aronix, especially for users with skin allergies.

1. Ventilate the room fully.

The liquid has a high boiling point and is not volatile, so fumes at room temperature do not cause skin problems. However, fumes generated by heating or UV curing may cause skin problems.

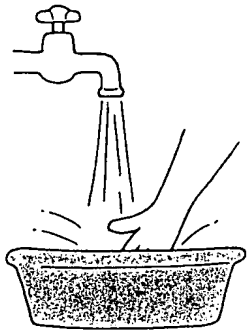


2. Wear appropriate protection.

(1) Wear protective gloves, aprons, and goggles, and do not handle with bare hands.
(2) When wearing protective gloves, do not touch the skin with contaminated gloves.
(3) Use natural rubber gloves. The liquid penetrates vinyl gloves.
(4) Exposed parts such as arms, should be protected by applying protective cream.

3. Wash skin immediately if it comes into contact with the liquid.

The liquid is clear and the user may be unaware of the initial contact. But if the liquid is not washed off, it may cause skin problems.
Wash the liquid off immediately with Aronix cleaner or soap and water. Solvent may facilitate penetration of the liquid through the skin, so do not use it.



4. Other precautions

- If skin problems occur, consult a doctor immediately and take medical care.
- Problems are limited to skin and do not affect other parts of the body.
- Cured material is not harmful.

Primary Irritation Index (PII)

Huntingdon Life Sciences UK reported the following irritation ranking; less than level 2 is generally accepted as a low-irritant oligomer.

PII Class	Description
0	non-irritant
> 0 — 2	mildly irritanting
> 2 — 5	moderate irritant
> 5 — 6	moderate to servere irritant
> 6	severe irritant

See the table for the PII of Aronix.

Storage of Aronix

Follow the NFPA classification when storing Aronix.

- Do not expose it to naked flames.
- Avoid direct sunlight, and store in the dark at temperatures below 40℃.
- Do not allow contact with metals such as copper or iron.
- Use resin-lined or stainless-steel or plastic containers.
- Avoid long-term heating at high temperatures.

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Caution: The date in this catalog is based on the results of careful experiments but we cannot guarantee that the same results will be obtained in practical use.

H14.6.1,000Ⓚ

（B）中にエチレンオキシド変性トリメチロールプロパントリアクリレートを５０重量%以上含む感光性樹脂組成物が、高感度でパターン形成性が良好で、なおかつレジスト剥離性が良好であることを見いだし、本発明を完成した。

【０００７】

【発明の実施の形態】以下、本発明について詳述する。本発明に用いるベースポリマー（A）としては、酸価が９５～２５０ｍｇＫＯＨ／ｇであることが必要で、好ましくは１１０～１６３ｍｇＫＯＨ／ｇである。酸価が９５ｍｇＫＯＨ／ｇ未満では、良好な現像性が得られず、解像力不良、パターン裾形状不良となり、不適当であり、２５０ｍｇＫＯＨ／ｇを越えると耐現像液性の低下に伴う細線の密着不良や、現像中での膨潤によって解像力不良となり不適当である。

【０００８】またベースポリマー（A）の分子量は５０００～２００００であることが必要で、好ましくは３００００～１２００００であり、更に好ましくは、５００００～１００００である。分子量が５０００未満では塗工乾燥によってフィルム化した際、十分なフィルム保持性が得られず、エッジフュージョンの原因となり不適当であり、分子量が２００００を越えると、十分な現像性が得られず、解像不良の原因となり不適当である。

【０００９】該ベースポリマー（A）として具体的にはアクリル系樹脂、ポリエステル系樹脂、ポリアミド系樹脂、ポリウレタン系樹脂、エポキシ系樹脂などが用いられる。

【００１０】これらの中では、（メタ）アクリレートを主成分とし、エチレン性不飽和カルボン酸や他の共重合可能なモノマーを共重合したアクリル系（共重合体）樹脂、アセトアセチル基含有アクリル系（共重合体）樹脂がベースポリマー（A）として好適に用いられる。

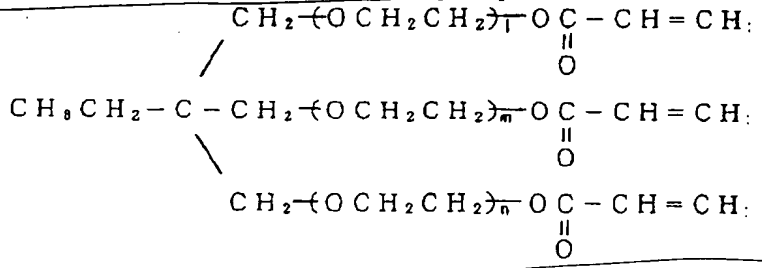
【００１１】（メタ）アクリレートとしては、メチル（メタ）アクリレート、エチル（メタ）アクリレート、プロピル（メタ）アクリレート、ブチル（メタ）アクリレート、ヘキシル（メタ）アクリレート、２－エチルヘキシル（メタ）アクリレート、シクロヘキシル（メタ）アクリレート、ベンジル（メタ）アクリレート、ジメチルアミノエチル（メタ）アクリレート、ヒドロキシエチル（メタ）アクリレート、ヒドロキシプロピル（メタ）アクリレート、グリシジル（メタ）アクリレートなどが例示される。

【００１２】エチレン性不飽和カルボン酸としては、アクリル酸、メタクリル酸、クロトン酸などのモノカルボン酸が好適に用いられ、そのほか、マレイン酸、フマール酸、イタコン酸などのジカルボン酸、あるいはそれらの無水物やハーフエステルも用いることができる。これらの中では、アクリル酸とメタクリル酸が特に好ましい。

【００１３】本発明においてはエチレン性不飽和化合物（B）中にエチレンオキシド変性トリメチロールプロパントリアクリレートを５０重量%以上含むことを最大の特徴とするもので、更には６０重量%以上含まれることが好ましく、特に好ましくは６５～８０重量%以上である。かかる含有量が５０重量%未満では良好な細線密着性が得られず好ましくない。

【００１４】エチレンオキシド変性トリメチロールプロパントリアクリレートとは以下の化１で表される。

【化１】



ただし l、m、nは０又は正数を示す。

【００１５】エチレンオキシド変性トリメチロールプロパントリアクリレート以外のエチレン性不飽和化合物としては多官能モノマーや単官能モノマーが単独、または２種以上用いられる。多官能モノマーとして具体的には、エチレングリコールジ（メタ）アクリレート、ジエチレングリコールジ（メタ）アクリレート、テトラエチレングリコールジ（メタ）アクリレート、プロピレングリコールジ（メタ）アクリレート、ポリプロピレングリコールジ（メタ）アクリレート、ブチレングリコールジ（メタ）アクリレート、ネオペンチルグリコールジ（メタ）アクリレート、１，６－ヘキサングリコールジ（メタ）アクリレート、トリメチロールプロパントリ（メタ）アクリレート、グリセリンジ（メタ）アクリレート、ペンタエリスリトールジ（メタ）アクリレート、ペンタエリスリトールトリ（メタ）アクリレート、ジペンタエリスリトールペンタ（メタ）アクリレート、２，２－ビス（４－（メタ）アクリロキシジエトキシフェニル）プロパン、２，２－ビス－（４－（メタ）アクリロキシポリエトキシフェニル）プロパン、２－ヒドロキシ－３－（メタ）アクリロイルオキシプロピル（メタ）アクリレート、エチレングリコールジグリシジルエーテルジ（メタ）アクリレート、ジエチレングリコールジグリシジルエーテルジ（メタ）アクリレート、フタル酸ジグ